Falco Builders Letter


Blaise Morand

Picchio and Falco over the French Alps.

A Legendary Airplane, The F.8L Falco

by Jean-Pierre LaFille
This article appeared in the June 1994 issue of Aviasport *in France. Special thanks to Kate Roy Christian for help with the translation.*

If for everyone the legendary car is signed "Enzo Ferrari", the comparable airplane generally comes from the drawing board of Stelio Frati. A gifted Italian aeronautical engineer with soft pencils in a velvet-gloved hand, Stelio Frati has designed numerous airplanes with pure, slender lines—including the F.8L Falco of which everyone speaks but which very few have seen other than in a painting or in a photograph.

I saw a Falco once, years ago in a hangar at the Annecy airfield, but it was a sad sight amid a flock of Rallyes and Jodels, cut off from its aeronautical universe by a doorway, and it was too dark to be able to admire the purity of its lines.

However, last April my favorite editor—of *Aviasport*, of course—told me to drop by the town of Nevers one day, where a man by the name of Xavier Beck was prepared to let me fly in his personal Falco. This is why, in early May, I barged into the hangar of the aero club. There I discovered a beautiful airplane with pure lines attired completely in white, without cowling or propeller, surrounded by several businessmen, all of them a bit dirty from working on their airplanes.

I let them work in peace, went to lunch with friends, and returned just in time to see the last piece of cowling go back on and to help push the machine out of its hangar. I was then able to interview Xavier Beck and to try out his beautiful airplane.

In This Issue:

Stelio Frati designed the Falco shortly after World War II. The prototype's engine was a 90 hp Continental, however after several flights—the Italian runways of the day being what they were—the engine was replaced by a 135 hp Lycoming 0-290-D2B.

The Series I Falco was born. It reached a maximum altitude of 18,000 feet, had a maximum speed of 202 mph and climbed at 950 fpm at a weight of 1,530 lbs. Almost immediately, the Series II was developed, with a 150 hp Lycoming O-320-A2A engine. It had a service ceiling of 19,000 feet, climbed at 1,070 fpm and had a maximum speed of 210 mph at a maximum weight of 1,700 lbs. The Series III Falcos had some minor improvements, and then, with a 160 hp Lycoming O-320-B3B, it became the Series IV. This Falco climbed at 1,140 fpm and flew at 212 mph in level flight according to the specifications. The gross weight was increased to 1,800 lbs.

Aesthetically, the Falco is almost perfectly designed—I say *almost* because, as the saying goes, perfection is not of this world. This impossible perfection might have been approached by using a slightly longer tail. The wing's aspect ratio is a modest 6.4, with 4° of aerodynamic twist and 5° of dihedral. The airfoil is the NACA $64_2212.5$ at the root and 64_2210 at the tip. In the end, the result is classic and in good taste. I note that the wing has stall strips approximately 25 centimeters long near the root of the wing, that the aileron and flaps are apparently of equal length, and that the tricycle landing gear is retractable.

Xavier's Falco is a Series III but equipped with a 160 hp engine and a fixed-pitch prop. Xavier bought the Falco in February 1992, flew it to Nevers, and disassembled the plane with the idea of doing a detailed inspection. He estimated this would take three months, but it ended up lasting two years.

The first problem was the disassembly itself. The wing is constructed in a single piece that includes the cockpit and forward section of the fuselage. The tail section separates at the trailing edge of the wing, a technique that permits easy construction, but laborious disassembly and transport.

At the beginning of this process, the 'master mechanic' in charge of the reconstruction had 100 hours of flying time, but he was, in fact, barely capable of recognizing a screwdriver. Xavier Beck simply wanted to do everything himself, but he was careful to get advice from others on the engine, airframe, woodwork, fabric-covering and general tricks of the trade.

Everything was restored to new condition, including all new screws, bolts and wiring, and while they were at it, the Falco was completely equipped and approved for IFR. Only the canopy was formed elsewhere, on a mold created jointly with a nearby aero club. At last, in February 1994, the machine was able to fly again, after two years that were a bit trying on a gentleman for whom the maintenance of airplanes is still not his chosen profession.

On this spring Sunday afternoon, I was finally able to take my place in the beautiful machine designed by Stelio Frati. I had some fear that the cabin might be a bit too cramped, but I was immediately surprised at finding myself rather at ease. The cabin width is adequate, however from the moment I closed the canopy, I regretted that it is not three inches higher, which perhaps might harm the looks but certainly not the speed.

The cockpit is well designed. There's a single throttle in the middle which is not bothersome except during formation flying. The rudder is a bit cramped, since the pedals are very close to each other, but that is not a problem as long as you do not have to apply the brakes. The rest is traditional.

Taxiing is rather surprising and not very agreeable for a pilot new to the Falco. The suspension is hard and the steering makes for a certain amount of sport. The steering mechanism is a bit unstable, and this requires constant corrections. The problems are further aggravated by a central heel brake, but it's well known that an airplane is not made to travel on its tires.

At takeoff, the acceleration is not very rapid, despite our modest weight of 1,650 lbs, the maximum authorized for aerobatics. This is normal, however, since the airplane has a fixed-pitch propeller optimized for cruise.

Once in flight, after an uneventful gear retraction, the airspeed indicator shows 115 knots and a rate of climb a bit better than 1,000 fpm. The only problem during the climb results from the absence of rudder trim, and this requires that I lean a bit heavily on the right pedal, or fly with the ball to the right.

In level flight at 1,500 feet and 11°C, the engine reaches 2,450 rpm, and the speed settles down at 140 knots—a very acceptable figure for an airplane that is, at present, deprived of its propeller spinner. But what is excellent about this Falco is the balance and feel of the controls. It is endowed with exact, regulation longitudinal stability, a modest induced roll, and insignificant adverse yaw. The little Italian two-place responds immediately to the slightest input, but without being too lively, too unstable or too undisciplined. In a steep bank, for example, it does not drop its nose and loses only a bit of speed, which is not the case with most airplanes.

The only slight defect in the controls might be a certain lack of authority in the elevator trim, but that is absolutely not a problem as long as you have the stick at your disposal.

In the stall, the ailerons are totally useless, but if the stall is clean, the wing does not tend to drop excessively, and the plane recovers easily after a perfectly acceptable loss of altitude.

During aerobatics, the Falco goes about almost everything from cruise speed, however the engine quits abruptly whenever the G's go negative. But apart from this, few single-place competition planes are as pleasant to handle or have controls as precise. At the very most, I might criticize it for a slight lack of authority in the roll to the right—probably due to the design of the rudder or a slight error in rigging.

On approach, after a lengthy deceleration due to the cleanliness of the design, I drop the gear, then the flaps, and approach the end of the runway at 70 knots in order to land at 58-60 knots, since the stall with full flaps is only 52-53 knots.

Like the flare, the landing is easy to do precisely, however our touchdown is too hard for a trailing-link gear, probably due to excessive pressure in the shock absorber struts. Next comes the deceleration which is not effective enough for my taste because, even with firm pressure on the brakes, you roll almost 1000 meters, to say nothing of the zigzags due to the difficulty of steering during braking.

And there you have the impression left me on by the F.8L Falco, an extraordinary "flying prosthesis," an aerial vehicle with astonishing purity of line (especially *with* a propeller spinner), but not very agreeable during taxiing and a bit cramped for comfort, particularly on headroom and especially during aerobatics.

Low Flight

Oh, I have slipped the swirling clouds of dust, a few feet from the dirt.
I have flown the airplane low enough to make my bottom hurt.
I've IFR'd the desert valleys, the hills and mountains, too.
Frolicked in the trees, where only flying squirrels flew.
Chased the frightened cows along, disturbed ram and ewe,
And done a hundred other things that you're not supposed to do.
I've smacked the tiny sparrow, bluebird, robin, and all the rest.
I've ingested baby turtle doves, simply sucked them from the nest.
I've flown through total darkness, just my passenger and me,
And spent the night in terror, of things I couldn't see.
I turned my eyes to heaven, as I sweated through the flight,
Put out my hand and touched the stall warning light!

anon. (thankfully)

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The Glider

Part 7 of a Series

by Dr. Ing. Stelio Frati
translated by Maurizio Branzanti

Chapter 4
Flight Stability

19. Static and Dynamic Stability

An airplane has longitudinal, lateral, or directional stability if it will return to its original attitude when disturbed by external forces from its straight-and-level flight by newly generated involuntary forces without the intervention of the pilot. Static stability is when spontaneous forces acting on the airplane will re-establish the conditions that were originally upset by outside forces.

While returning to its original setting, it is possible that the point of equilibrium is passed, thus beginning a number of oscillations. These oscillations may decrease or increase in amplitude. If the oscillations decrease at a fast rate (i.e. are "damped"), it means that the plane possesses not only static stability but also dynamic stability. An airplane requires static stability *and* dynamic stability to quickly reduce any oscillations.

The components for stability and maneuvering are the entire tail section and the ailerons. The tail section is usually characterized by a fixed portion and by a movable one used for maneuvering, in other words, for changing the plane's attitude or correcting accidental variations. The ailerons are used for lateral maneuvering or to re-establish lateral stability.

20. Longitudinal Stability

We have seen when discussing the various wing airfoils how these are by nature very instable. Their instability is due to the movement of the center of pressure with changes in the angle of incidence. If the lift *L* is equal to the weight *W*, when both these forces are at the center of gravity CG, we will have equilibrium because the resolution of the forces is nil, as is the moment of these forces with respect to the CG location.

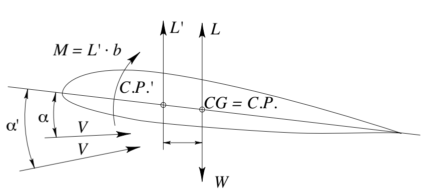


Figure 4-1

Consider what happens if the angle of incidence is increased to α'. The center of pressure will move forward from its original position to *CP'*. Lift *L* now has a moment with respect to the point CG, which is:

This moment will have the tendency to increase the angle of incidence, thus moving farther away from a position of equilibrium.

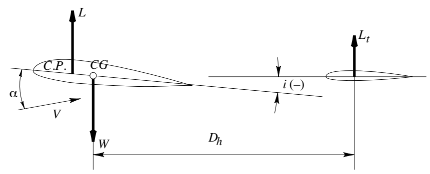


Figure 4-2

An opposite moment will be necessary to re-establish equilibrium. This is achieved by means of the horizontal tail, whose moment with respect to the center of gravity is:

where

L_t = Total lift (or negative lift) of stabilizer
D_h = Distance of horizontal tail center of pressure from center of gravity CG

With respect to the individual location of the horizontal tail and the wing, the angle between the wing chord and the stabilizer is called the horizontal tail angle. In Figure 4-2, this angle i between the wing and the stabilizer is a negative value.

Moment for the Complete Design. Let us now examine the moment of the complete aircraft design where the horizontal stabilizer is at given angle *i*. In the polar chart, the moment curve is still a straight line but with a steeper slope then the ones we have seen for the wing itself when only the partial aircraft was being considered—in other words for an aircraft design without considerating the tail section.

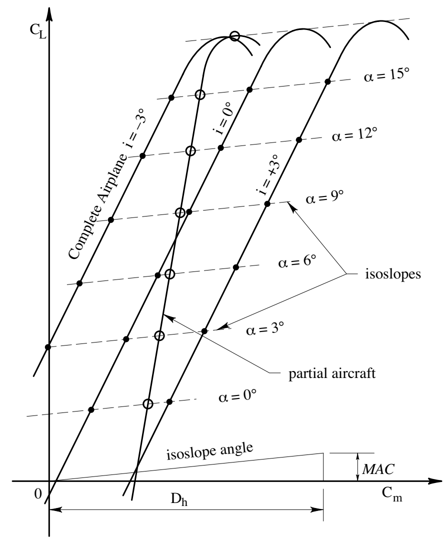
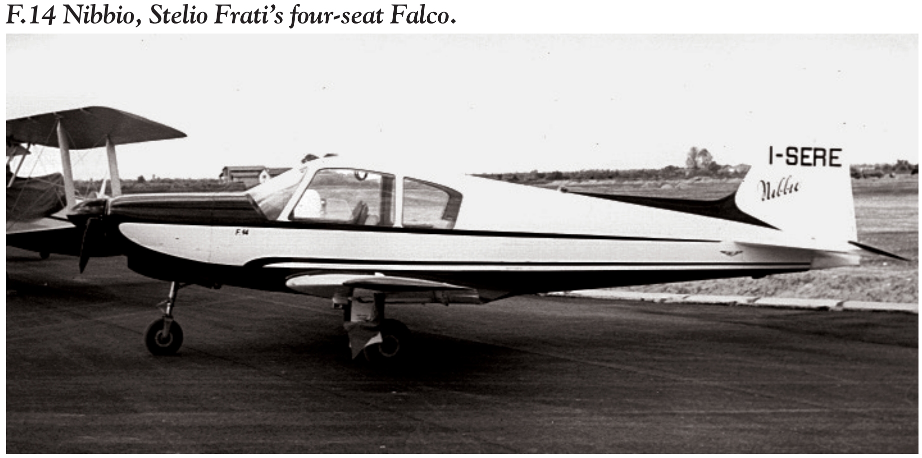


Figure 4-3

By changing angle *i*, we generate different moment curves, but notice that these curves are essentially parallel to each other. This is because they benefit from the property that the incidence angles—which affect the aircraft attitude when changing angle *i*—will move on lines of equal slope, lines called isoslopes. The slope is given by the ratio MAC/D_h—the average wing chord over the horizontal tail distance. These isoslope lines are used to determine the moment curves for the complete aircraft design.

We will avoid using the analytical method of establishing these curves because of the many factors involved—factors that are, at times, not easily determined. Therefore we must use a wind tunnel to obtain acceptable results. You run tests by changing the horizontal tail angle and obtain the different moment curves needed for longitudinal stability studies.

F.14 Nibbio, Stelio Frati's four-seat Falco.



Italy's Speedy Seaplanes

by Stephan Wilkinson
This article appeared in the June 1994 issue of Alfa-Romeo's il Quadrifoglio *magazine*.

What comes to mind when the subject is early jet fighters? The German Luftwaffe, perhaps, or the RAF, or the U.S. Air Force—all inarguable pioneers in the field of high-speed turbine flight. Will it come as a surprise, then, to learn that in 1935, Italy had the earliest high-speed air force research squadron probing the forbidding world of what would come to be known as "the sound barrier"? And that in 1940 the Caproni-Campini N.1 became the second jet to fly, nearly nine months before the British launched an experimental jet and well over two years before the Americans did?

Italy's role in developing aircraft of enormous speed and capability as early as the 1930s was brought to a premature end by the almost-total destruction of the country's aircraft industry in the early stages of World War II, but it all began with a remarkable series of highly specialized racing aircraft built for the aviation equivalent of the America's Cup—a competition for a piece of sexy bric-a-brac called the Schneider Trophy. Between 1913 and 1931, military and civil aircraft from the United States, England, France and Italy fought a seesaw battle for possession of a silver-and-marble trophy depicting a winged, nude female figure snatching a kiss from a wave-borne zephyr.

Oddly enough, the Schneider Trophy was solely for seaplanes, a form of aircraft that combines the worst of two worlds: on the water, seaplanes are delicate, expensive, dangerous, barely maneuverable boats. In the air, they suffer from the enormous drag and weight of their pontoons or hulls. (Seaplanes come in two basic varieties: "floatplanes," which perch atop pontoons, and "flying boats," which have hull-shaped fuselages for flotation. Italy tried both types in the Schneider Trophy races.)

Frenchman Jacques Schneider's fascination with seaplanes was part of a naïve view common in early aviation—and not unknown among seaplane buffs today—that because the world was 70 percent water, and that such water could provide a near-infinite number of runways of virtually unlimited length, God meant airplanes to alight on lakes, rivers and oceans rather than on long, narrow, flat pieces of real estate. But to a fast-moving airplane, water is hardly any less solid than concrete, and when it is disturbed by anything more vigorous than lakefront ripples, it is no good as a runway no matter *how* long it is.

The Piaggio P.c.7 "flying submarine" never flew.

Nobody knows how fast the Schneider racers might have flown if they were landplanes with sleekly faired wheels or, better yet, retractable landing gear. But certainly they would have been by far the fastest airplanes in the world, particularly the Macchis and Savoias built and flown by the Italians. They were fast enough despite their floats and hulls, and during the scant 18-year history of *La Coupe d'Aviation Maritime Jacques Schneider*, seaplane speeds rose from just under 61 mph to just over 407. No other speed event in history has fostered such an advance in so short a time.

The first Italian Schneider Cup contenders were cumbersome-looking but relatively efficient biplane flying boats, and in 1919, one of them, a Savoia S.13, apparently won the first Schneider race that Italy entered. But the Italians were refused the trophy by the British, who sponsored the race that year. Due to a misunderstanding, they had been rounding the wrong marker at one point on the race course. (The Schneider contests were against-the-clock races, one airplane at a time, so each pilot had to find his own way around the course.) The Italians never forgave the English, and until the end of the series in 1931 were consumed by a desire to humble the Brits.

Italy swept the 1920 and '21 contests after both the French and English teams withdrew with equipment problems, but in 1922 the English forestalled an ultimate third Italian victory. (Schneider Cup rules specified that the trophy would be retired and become the permanent possession of any nation that won it three times within five years.) By 1923, the Americans had become aware of the Schneider catfight and came to Europe with a covey of tiny Curtiss float biplanes that exhibited a precedential streamlining technique: their watercooled Curtiss V-12 engines were cowled as tightly as a mugger with pantyhose over his head, the very shape of the cam covers and cylinder banks defining the aluminum that sheathed them. A Curtiss won in 1923 and '25, and thereafter, virtually every racer copied many of their design features.

For the rest of the decade, the victories seesawed back and forth between the British and the Italians. (Congress cut off funding for American racers after 1925.) The Italian banner was largely borne by a superb Macchi design, successively improved and re-engined as the M.39, M.52, M.67 and ultimately the awesome M.C.72. The Macchis were variations on one of the most arrogant-looking yet beautiful airplanes of all time, with a distinctive, symmetrical tailfin that gave it the profile of a perch, a tiny cockpit exactly halfway between prop spinner and tail, and a long, passionately shaped cowling that was in a sense the aerial paradigm of a P3 Alfa's.

The Savoia company also developed a revolutionary but fatally flawed contender, the S.65, which consisted of little more than a zucchini-shaped fuselage atop a wing and two floats, with a pair of tiny booms stretching aft to support the tail. The fuselage held two Isotta-Fraschini engines of 1,080 hp each, one pointing forward, the other aft, with a propeller at each end of the pod.

Schneider racers' engines had become so large, and the airframes so light and tiny, that engine torque tried to rotate the entire airplane around the crankshaft and propeller rather than the reverse. Con-

Francesco Agello on the float of the record-breaking Macchi M.C.72.

trol, especially at low takeoff speeds, was marginal. The principle behind the S.65 was that the torque of the two identical engines rotating in opposite directions would cancel each other out. Only one Italian-team pilot, Tomaso Dal Molin was small enough to fit into the cockpit between the engines, and he was killed when the sole S.65 crashed during a test run in 1930.

One of the most complex and visionary of all the Schneider Cup racers was an Italian design that ran but unfortunately never made it off the water. The Piaggio P.c.7 dispensed with heavy, bluff floats by instead perching atop a single small, sleek, bladelike hydrofoil. And the hydrofoil would even produce added lift rather than drag in flight. Since a hydrofoil provides no flotation at standstill or low speeds, however, the Piaggio was built with watertight wings and fuselage, which floated upon the water at rest, and a speedboat water propeller under its tail.

The drill was for the pilot to fire up the airplane's light 800-hp Isotta-Fraschini V-12 engine and engage the waterscrew to drive the airframe to planing speed. (The air propeller was at this point decoupled from the engine, its blades locked in a horizontal position so they wouldn't drag in the water.) When the hydrofoil achieved enough speed to lift the wings and fuselage well clear of the water, the air propeller was to be engaged, the waterscrew de-clutched and its blades feathered for streamlining, and the Piaggio would accelerate to liftoff speed driven by its conventional propeller.

We can only assume that the Italians were unable to find a pilot with enough arms and legs to perform all the necessary clutchings and de-clutchings while simultaneously working the control stick and rudder pedals—a touchy business in a racing seaplane under the best of conditions—for the P.c.7 never achieved more than motorboat speeds and notorious publicity: the Italian press couldn't resist calling it "the flying submarine."

In 1927, '29 and '31 (the competition had by then become biannual), the British won the race with S.4, S.5 and S.6 versions of its splendid Supermarine racer, thus ending the series. The Supermarine was designed by a self-taught engineer named Reginald Mitchell, who went on to design the loveliest single-engine fighter ever built, the graceful, potent Spitfire. Without the benefit of what Mitchell had learned from his Schneider Trophy racers, the Battle of Britain would almost certainly have been lost and the course of World War II perhaps drastically changed.

The real legacy of the Supermarine racer, however, was its engine—a supercharged, 1,900-horsepower Rolls-Royce V-12 called the Model R. The R would go on to become the Rolls-Royce Merlin, which powered some of the fastest, most reliable warplanes of World War II, including not only the RAF's Spitfires, Hurricanes, Mosquitos and Lancaster bombers but the U.S. P-51 Mustang, generally held to be the single most important fighter of the war.

Another important contribution of the Schneider series was the boost that it provided to the development of high-octane gasoline, which gave Allied aircraft an enormous advantage during World War II. The Luftwaffe flew on 87-octane avgas, for they hadn't discovered the secrets of octane-boosting to prevent the detonation that accompanied increased compression ratios, but U.S. and British engines used 100-, 115- and even 130-octane gasoline.

The Rolls-Royce R particularly stoked the development of octane-boosting compounds such as benzol and tetraethyl lead, for it was supercharged to intake pressures never before attempted in so powerful an engine. (The R ultimately cranked out 2,530 hp—a then-awesome 1.18 hp per cubic inch.) The English became particularly adept at fuel-brewing and induction magic, and it was they who helped the Italians solve the problem that lost them the Schneider Cup. After the series was finished forever and old rivalries could be ignored, a British fuel expert visited the Fiat engine factory and quickly spotted the Macchi M.C.72's Achilles Heel.

At 400 mph, the Englishman explained, air was being rammed into the engine's induction scoop at such pressures that the fuel/air mixture was being fatally leaned out, creating destructive backfires. As aviation writer Bill Sweetman later put it, "A backfire when performed by a small car engine can send law-abiding citizens diving for safety; the [Macchi's Fiat] AS6, with 51.1 liters and 24 cylinders, was prone to blasts on a Vesuvian scale."

With the help of their fomer adversaries, Fiat's engineers were able to crank 3,000 hp at 3,300 rpm out of the AS6 and thus use it for one more memorable run. Motor-racing is filled with what-ifs and might-have-beens, but it's worth considering the fate of the M.C.72 that lost the final race, in 1931, to England's Supermarine S.6B. The Macchi's Fiat V-24 was actually two nose-to-nose V-12s driving through a central gearbox and turning two counter-rotating propellers. It never made it to the starting line, due to those enormous backfires created whenever the airplane reached racing speed. (We're talking big-time explosions here. During a test run two days before the race, one M.C.72 was blown apart with such fury that a charred sleeve of the poor pilot's uniform was found fully three kilometers from the point of impact.)

In October of 1935, its engine problems apparently solved with the help of the English, a very brave Sgt. Maj. Francesco Agello of Italy's High-Speed Training Establishment flew the sole surviving Macchi M.C.72 to a world absolute speed record of 440.68 mph—the fastest any human had ever traveled in any vehicle of any kind, and exactly 100 mph faster than the S-6B's trophy-winning time in 1931.

Today, 59 years later, that record still stands as the fastest speed any propeller-driven seaplane has ever traveled. *Ever.* No other aviation speed record has lasted as long.

Performance Testing 101

by Alfred P. Scott

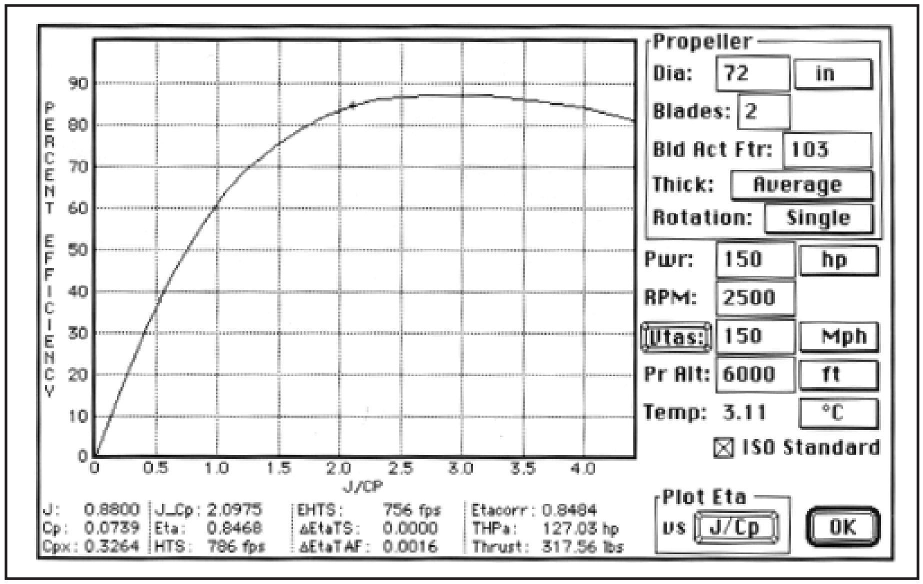
In the early 1940's, the Boeing Aircraft Company had just finished building the B-17 bomber, and to fulfill the requirements of the Air Force, Boeing needed to supply a flight manual that would show the performance and range of the airplane at various weights and power settings. With long-range bombing missions, it would be essential that the crew could accurately predict the speed and fuel consumption of the aircraft—and could also tell what would be the most efficient power setting for any altitude, temperature, and aircraft weight.

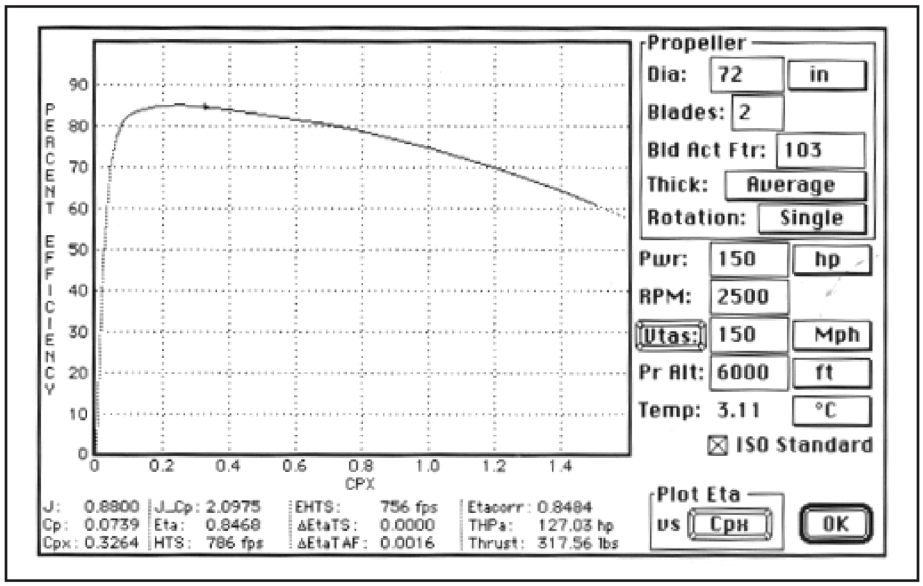
Prior to that time, most performance charts for aircraft flight manuals were developed with the empirical method. The aircraft was flown in various regimes, the performance data was duly noted on graph paper, and then an engineer would take a flexible ruler and draw some curves that seemed to be the most likely average.

But the B-17 required more accuracy than that—after all, there weren't likely to be a lot of friendly FBO's and alternate airports scattered along the way. The Boeing engineers had to *know* the characteristics of the airplane. Because there was no way to determine the efficiency of the propellers, Boeing's test pilots took the plane to 20,000 feet, shut the engines off and ran the plane through a time-honored glider-test procedure.

The absurdity of this did not escape notice of Boeing's management, who asked the Flight and Aerodynamics Department to see if they could develop a better method. A small team of engineers, under the direction of Edmund T. Allen, developed a mathematically rigorous method of performance testing and analysis that was used for the B-17, B-29 and other aircraft during WWII. This method was described in the January 1943 *Journal of Aeronautical Sciences*. The method is precise, has stood the test of time and technological improvements, and is the method that is used by virtually all of the major aircraft manufacturers to obtain performance data on their aircraft.

The most important product of this process is the 'miles-per-gallon chart'—a graph which shows all of the most efficient power settings for various weights and temperatures at a given altitude. Simply put, the miles-per-gallon chart tells you all you need to know about the aircraft to select a





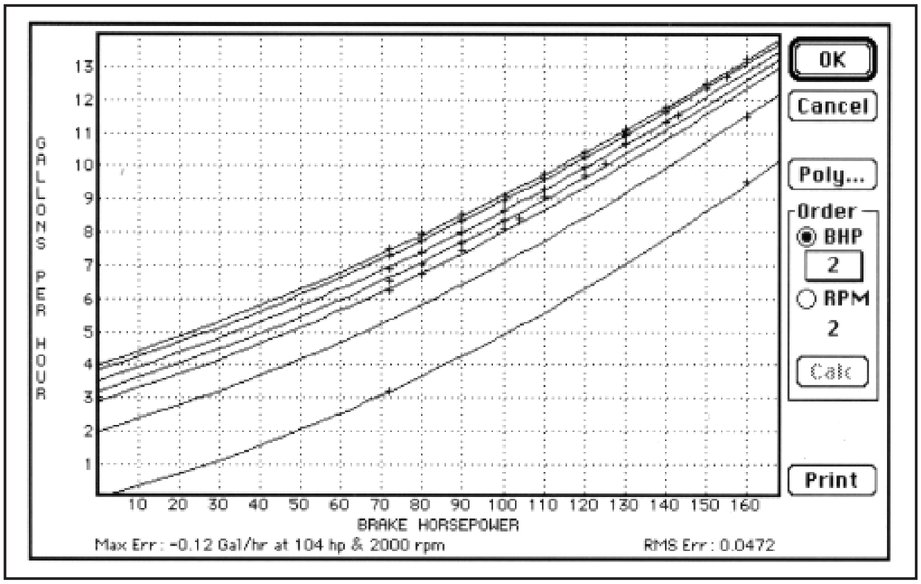
Top: The propeller efficiency calculator showing the traditional view of efficiency (Eta) vs J/Cp^1/3—which is the propeller advance ratio divided by the cube root of the coefficient of power. Above: Another view of the same thing, but looking 'sideways' through the three dimensional curve. Here you see Eta vs Cpx—which is the adjusted coefficient of power.

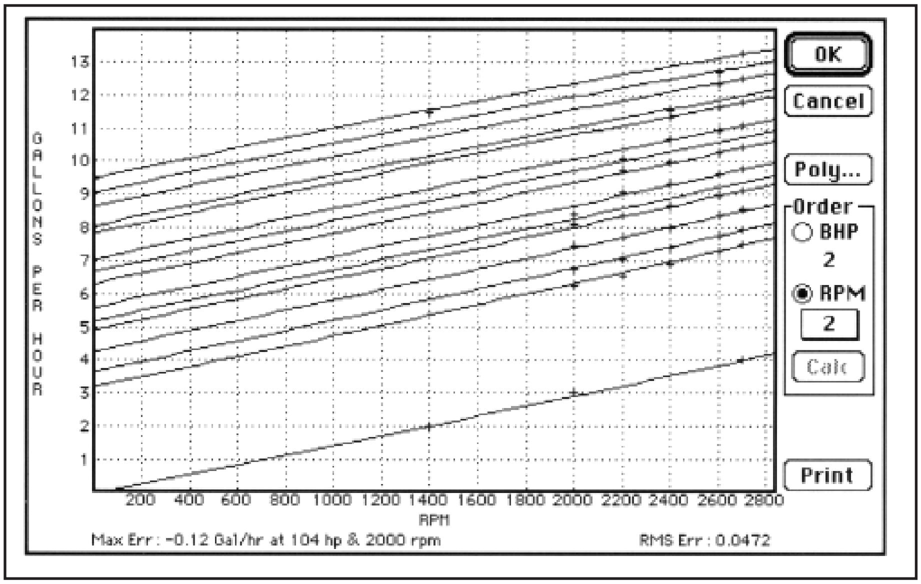
power setting that will give you the most efficiency.

Under the direction of Roy LoPresti, Mooney Aircraft was the first to offer a miles-per-gallon chart in the flight manuals of the 201 and later the 231. Roy recognized that Mooney pilots were fanatical about fuel efficiency, and he hired an aeronautical engineer, Fen Taylor, to do the flight testing, analysis and charting.

Fen Taylor is widely recognized as one of the world's experts on this subject, indeed he was a member of Ed Allen's original team of engineers at Boeing that 'wrote the book' on the method. Fen's wife, Dorothy, is also an engineer, and they work together as consulting engineers on performance testing and analysis. If the performance section of the flight manual for your production aircraft was not done by the Taylors, then chances are the engineer who did the manual once sat at Fen Taylor's feet and learned the method from him.

I became interested in all of this in the mid-eighties. With the Falco, there were no good performance charts available, and I wanted the builders of our aircraft to have performance charts that were as good as those offered for any production aircraft. There was the added problem that no two Falcos performed exactly the same—some had full gear doors and other refinements and were exceptionally fast, while others were 20 and 30 mph slower.





Top: Curve-fitting the fuel flow of the engine. This is a three-dimensional curve—shown here is brake horsepower vs gallons per hour. Above: Here's the same curve plotted with revolutions per minute vs gallons per hour.

So I approached Fen Taylor and hired him to school me in the method. I didn't want him to test a Falco, but rather 'give me the tools' so that we could test the aircraft ourselves. At the time, I had no concept of what I was getting into or even what was involved. Oh, was I naïve!

Fen and Dorothy prepared a thick engineering report and when it arrived, I almost cried. Fen, Lord love him, is one of those people who understands a subject intimately but who can barely explain it. The report was a bewildering collection of look-up charts, formulas and frightfully complex explanations. It seemed almost beyond humankind to understand it.

But I wore that guy down and made Fen explain it all to me. We had endless conversations as I pieced it all together. And slowly as I came to understand the method, the awful truth sank in—it was useless to any normal person. Ya see, the problem is that once you've done the flight testing—which is fairly easy—you have to spend an enormous amount of time analyzing the flight data to be able to draw the charts. Roy LoPresti told me it took a couple of engineers three months just to do the 201.

"Didn't you ever use a computer for any of this?" I asked Fen.

"Well, not really because it wouldn't help that much. There are all these things along the way that you can't solve on a computer, so we just used look-up charts for all of it." This didn't seem to make much sense to me, so I kept pressing for the equations for each step of the process.

There were three principal stumbling blocks—propeller efficiency, engine power, and fuel flow—which prevented computers from being used to automate this process. For these I turned to Jim Petty, a Falco builder who during the day worked as a program manager for advanced technology at the USAF's Wright-Patterson Research Center.

Jim Petty is a mathocist. Tell him about a problem and simply out of interest he will work on it until he comes up with an equation or until his brain explodes. Over the years, I've hit him with very few problems that he couldn't solve—if *you* know how to do a parallel offset of a Bézier curve, lemme know!—but propeller efficiency, engine power and fuel flow have all been felled by his remarkable brain.

And my contribution has been to put it all in a stand-alone computer program that handles the entire process and which spits out the miles-per-gallon charts like they were popcorn. The program is called Benchmark, and in a couple of hours with Benchmark, you can duplicate the entire analytical process that takes months when done the old way.

So without getting into sleep-inducing math, let me take you through the methodology of this little-known branch of aeronautical engineering. The neat thing is that once you take away the horrendous math, the flight testing is not difficult at all. And it means that whether you own a Beech Staggerwing, a Cessna 185 on skis, a DC-3, a Lancair IV or even a Beaver on floats with a canoe strapped to the struts, you can easily crank out all the charts you'll ever need for *your specific airplane*, not a factory-average airplane.

Instrumentation

About 80% of the bad data and repeat flight tests result from instrumentation problems, thus it is essential that you use instrumentation with known accuracy so that all variables can be measured accurately. This is the least-fun part of the process, but it's important stuff.

You need to calibrate the instruments. An instrument shop can do this for you, or you can do it yourself. The easiest do-it-yourself calibration is also the most important—the airspeed indicator is calibrated with a water manometer, and Benchmark has a calculator to assist you with the conversions. For best results, you should use a sensitive airspeed indicator. This is a two-handed instrument that looks something like an altimeter and reads in one-mph increments.

Ideally, you will calibrate the airspeed indicator, tachometer, altimeter and manifold pressure gauge. You end up with a table of indicated-vs-actual data. In the manual method, you plot this on a chart, draw a line through the data points and then use this chart to make corrections.

With Benchmark, you type in the numbers and then choose the Analyze Airspeed Indicator command from a menu. This provokes Benchmark into a frantic activity of curve-fitting; it calculates a slew of curves based on the data and then waits for you to pick the one that you want. You get to see each curve plotted against the data and can zoom in and out to look at it.

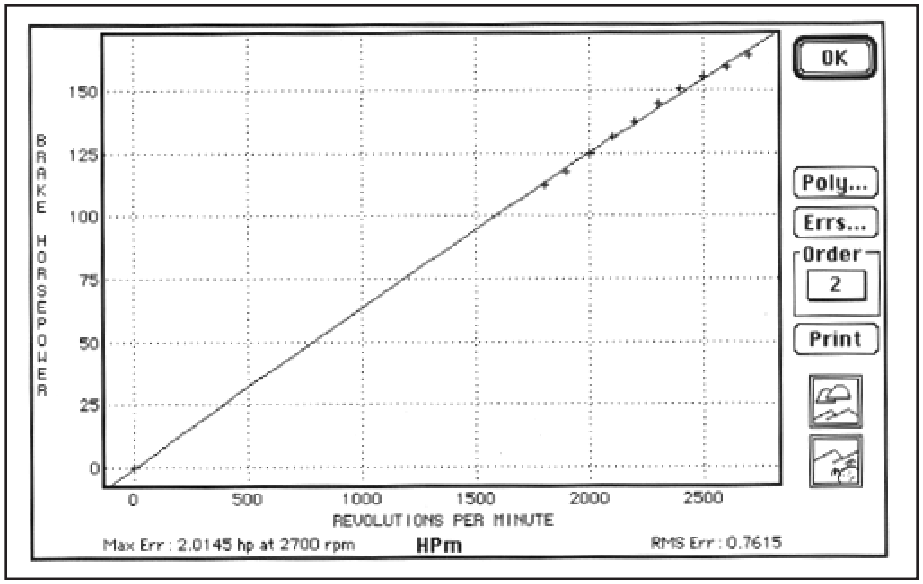
This business of curve-fitting is central to how Benchmark works, because almost everything that is special about an instrument, engine or airplane is represented by a curve. The nice thing is that it's actually fun. And once the instruments are calibrated in Benchmark, the corrections of the data are handled automatically.

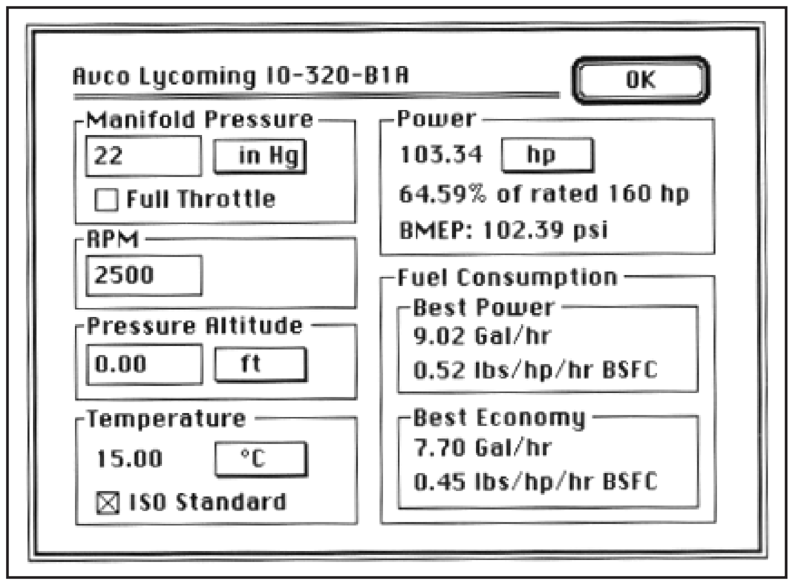
The Propeller

The primary technological advance achieved by Ed Allen's team at Boeing was a method of accurately predicting propeller efficiency. They went through tons of data from the NACA ten-foot propeller wind tunnel and arrived at a method of reducing it down to a common denominator. This was essentially a statistics problem, and they developed something called the Boeing General Propeller Chart.

It's a three-dimensional chart—think of it as a hill—based on a couple of obscure parameters that are calculated from the specifics of the propeller, engine power, propeller rpm, airspeed, pressure altitude and temperature. You look up the efficiency of the propeller—the 'height of the hill' at that point—and then make a number of adjustments for some other things peculiar to propellers.

This is handled automatically in Benchmark, and all you have to do is type in the basic data on the propeller—diameter, number of blades and blade activity factor. The activity factor is something you'll need to get from the propeller manufacturer, and it's roughly equivalent to a wing's aspect ratio but in the case of a propeller the tip is travelling at a much greater speed and thus needs some compensation. There's a lot of calculus in a blade activity factor, and you don't want to know about that.





Top: Curve-fitting the maximum engine horsepower vs rpm. You click on the icons in the lower right to zoom in and out. Above: Once the engine is modeled, you can use the engine power calculator.

With this data in hand, Benchmark can then calculate propeller efficiency in a flash, and there's a propeller efficiency calculator so you can play with various settings, watch the numbers change and see where the propeller falls on the curve. It also enables you to go to parties and exhibit True Nerdism by discussing your equivalent helical tip speed and delta eta for total activity factor.

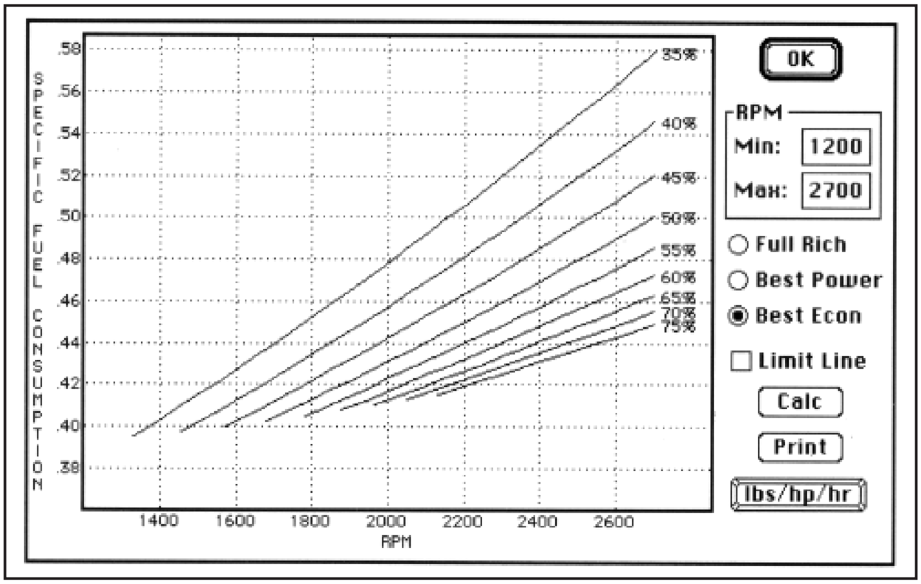
The Engine

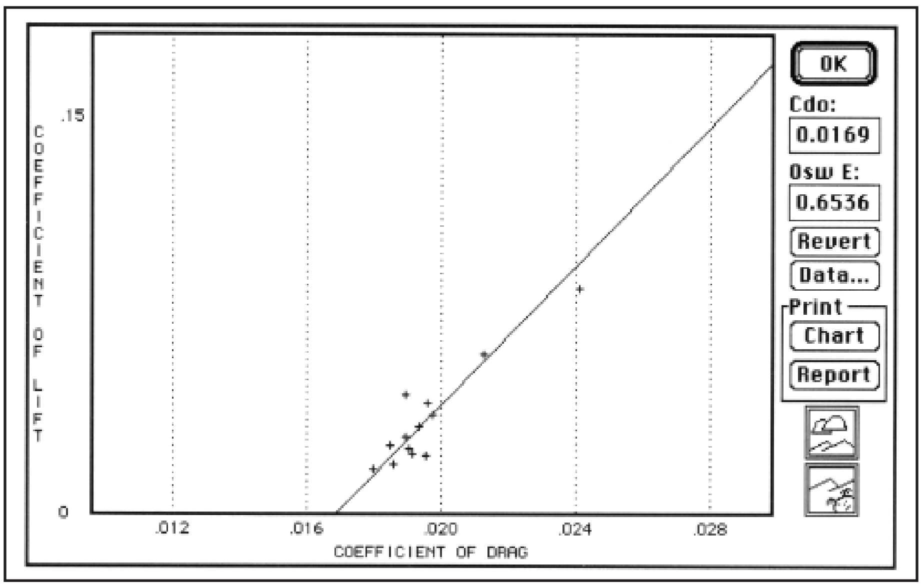
You need to know the power that the engine is putting out at each power setting. This information is very important, and it must be accurate.

The best way to do this is to use a torquemeter. This is an extremely expensive gizmo that you bolt between the engine and propeller. It's really nothing more than a propeller extension with a bunch of strain gauges that measure the torque and then sends this information to a cockpit data recorder. With such a device, you can get precise data about the power that the engine actually puts out when installed in your plane.

This really isn't a practical solution for an individual. For us, the best solution is to use the sea level and altitude performance charts published by engine manufacturers. The sea level part of the chart is an engine-specific chart normally derived from a dynamometer (or torquemeter data), while the altitude part is an industry-standard, physics-based projection of that data.

One of Jim Petty's major accomplishments was to reduce this charting method to an





Top: Here's a chart of specific fuel consumption vs rpm.
Above: Analyzing a drag polar flight test produces this chart and the two 'magic numbers', the Cdo and Oswald E.

equation. The Petty Engine Power Equation has been reviewed by a number of powerplant engineers and all agree that it duplicates the sea level and altitude performance chart method. The equation is a real beaut, and I'll spare you the sight of the gruesome thing. (If you're interested in the equation, see the May 1988 *Light Plane Maintenance*, "Percent Power, Wherein Alfred P. Scott and James S. Petty Wrestle a Giant Man-Eating Polynomial to the Ground" by Kas Thomas.)

To calculate engine power, Benchmark needs to know about three curves for the engine: friction horsepower, maximum horsepower and maximum manifold pressure—all for sea level. For those of you without a torquemeter, you get this data by looking up points on the engine manufacturer's sea level performance chart. Benchmark then goes through the usual curve-fitting dance for each of the curves.

Fuel flow, in gallons-per-hour, is a function of horsepower and rpm. You get this data from the published charts supplied by engine manufacturers (or from flight data), enter it in Benchmark and go through a curve-fitting process—only this time the curve is a three-dimensional shape, and the process is a bit slower. But Benchmark will fight bravely with your data and in the end you can get a curve that will easily model the fuel flow of the engine for three conditions: full rich, best power and best economy.

There's an engine power calculator in Benchmark, so you can 'run the engine' at various power settings, altitudes and temperatures and immediately calculate the engine horsepower, BMEP, fuel consumption and brake specific fuel consumption. You can also chart specific fuel consumption vs RPM.

The Airplane
Relatively little information is needed about the airplane. The important parameters are wing span, wing area, weight and number of engines.

The Pitot-Static System
The pitot-static system introduces a whole new level of errors on top of the airspeed indicator error. Generally, the pitot tube is a minor problem, since a well-designed pitot tube has little or no error up to about 15° to 17° angle to the relative wind. The static ports, however, are very sensitive to cross-flow, shape and location on the aircraft. Tests of some aircraft have shown errors of 5% to 10%, thus it is essential that the pitot-static system be calibrated.

This is done with a flight test on a day where there is no wind and you have smooth air. You fly the airplane at various airspeeds and record the indicated airspeed and the ground speed. There are several methods that can be used.

The method used at Mooney and many other aircraft companies is the theodolite method. In this case, a surveyor's instrument was connected to a data recorder. The aircraft was flown down the center of the runway and an engineer would track the airplane by keeping the crosshairs of the instrument on a spot on the airplane. The data recorder would spew forth volumes of data on the azimuth and elevation of the instrument at fixed-time intervals.

From a plot of this data, they could determine, by the rate of swing of the instrument, when the airplane was perpendicular to the instrument and thus the airplane's speed. One run is made for each speed. As you might imagine, this method is very accurate, but it's expensive and difficult.

For the rest of us, a better solution is to establish a measured speed course of about two miles length with obvious markers at each end of the course. Fly the course and time the runs. Benchmark has a calculator to convert the data to the required indicated vs calibrated airspeeds. This is entered into Benchmark and then you fit yet another curve to the data, just like an instrument.

The advent of GPS systems, though, may provide an even better method since a GPS system can record ground speed with great precision.

Induction System Ram Recovery
When an aircraft flies through the air, the air that impacts the plane also forces itself into the induction system and can boost the manifold pressure. The maximum potential boost is a function of indicated airspeed, indeed the airspeed indicator is nothing more than a pressure gauge with the dial face painted in mph, knots or km/h. The efficiency with which the induction system converts this available pressure into a plenum static pressure is known as the ram recovery.

The ram recovery flight test is the simplest of all. You just fly the airplane at full throttle, write down the pressure altitude, indicated airspeed, engine rpm and indicated manifold pressure. Enter this into Benchmark, and it will calculate the ram recovery. Karl Hansen's Falco gets about 85%, but that is without an induction filter.

The Drag Polar Test
Now this is the 'what'll she do' test where we find out what the airplane is really like. The purpose of the drag polar test is to calculate the two 'magic numbers' that define the airplane: the Cdo and the Oswald E. When you have these two numbers, the cruise performance of the airplane is mathematically predictable.

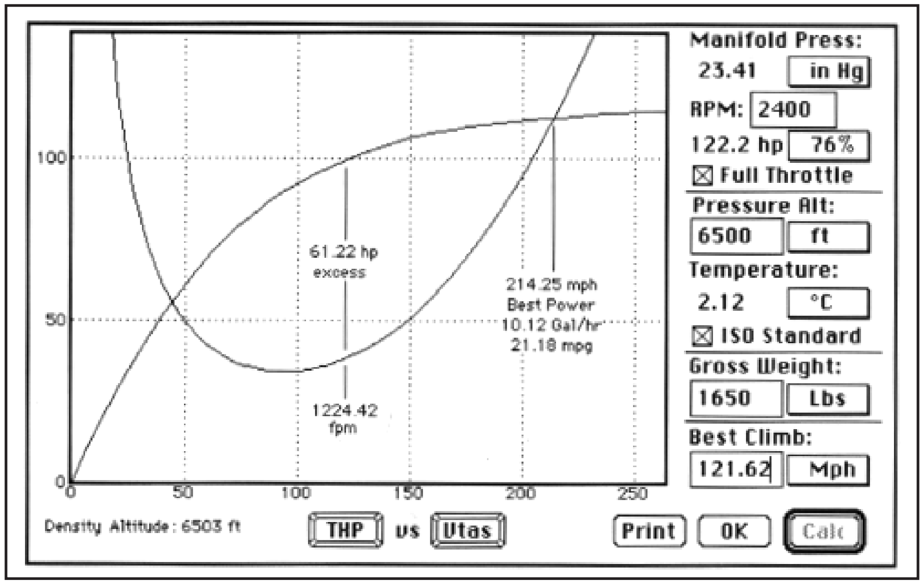
In order to get these numbers, you fly the airplane at the full range of speeds, from very slow to very fast. What you really want to know is the coefficient of drag and coefficient of lift at each speed, so not only do you need to know the speed at each point in the test, you also need to know the weight of the airplane at that moment.

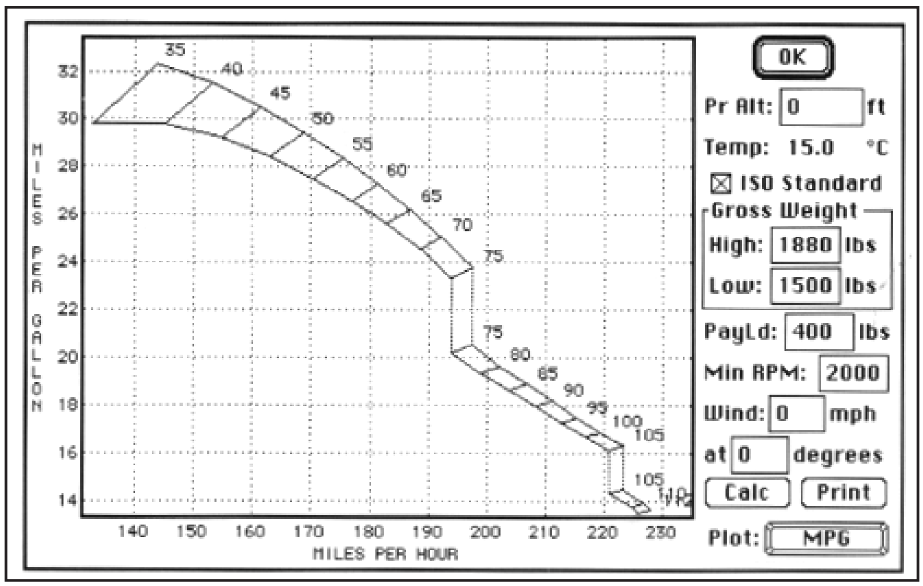
In a typical drag polar test, you and your data-recording 'flight engineer' fly the airplane at a single altitude, say 6000 feet, set the propeller rpm to maximum rpm and never touch it, and then change the power settings with the throttle. At each point, you must lean to best power, and you must let the airplane settle down.

You write down a lot of numbers and then you enter these numbers into Benchmark and crunch them. At each point in the test, you must calculate the coefficient of lift and the coefficient of drag, and then by plotting all these on a chart you can determine the Cdo and Oswald E. Curt LoPresti says this process used to take him a half day when he worked at Mooney; Benchmark does it in a few seconds.

Once you've got an airplane by its Oswald E, you can predict its performance at any altitude, temperature, weight and power setting. Benchmark has a speed calculator which plots power required against power available, and shows not only the speed of the plane in level flight but also the maximum excess horsepower at the best climb speed, and it translates this to the climb rate in feet per minute.

This rate of climb is slightly optimistic because in an actual climb the wing is flying slowly through the air and the fuselage is bathed in higher speed air from the propeller. This can be determined by doing a series of 'saw-tooth climb tests' to determine actual climb performance vs that predicted by excess horsepower. I've not yet put that capability into Benchmark because I've never had an engineer give me an equation for the relationship. Instead, everyone seems to talk in terms of tacking a few points onto the Cdo as an educated fudge factor.





Top: The real fun begins when you use the airspeed calculator, which shows curves for power required and power available. The speed in level flight is where the two curves cross at the right. Maximum excess horsepower translates to the best climb speed and rate. Above: Here's the way the miles-per-gallon chart looks on the screen.

The Miles-Per-Gallon Chart
At last we come to the miles-per-gallon chart, the *raison d' être* of Benchmark. You choose the altitude for the chart as well as two gross weights—maximum gross weight and the lowest conceivable cruising weight—and the minimum engine rpm you are willing to use. This minimum engine speed is normally set by the engine manufacturer, and it's necessary to keep Benchmark from suggesting a too-low engine speed, which it otherwise would do because the lowest engine speed is normally the most efficient one.

Click on the Calc button and Benchmark begins an enormous series of calculations. Benchmark begins with full throttle and maximum engine rpm for the first calculation, and then steps down to 35% power in 5% intervals. In each case, it starts at the minimum rpm and increases the rpm as required to get the desired percent power and also to select an rpm/manifold pressure combination that does not exceed the maximum manifold pressure limit.

I shudder to think of anyone ever doing this by the manual method; I'd guess each chart would take an engineer a week or more. My old computer used to take four minutes to do these calculations. My present machine can do it all in four *seconds*.

The standard miles-per-gallon chart has a temperature adjustment grid on the bottom to provide for non-standard conditions. This chart is based on the assumption that if the temperature is non-standard, the pilot will increase or decrease the manifold pressure to maintain the percent power.

I've found this difficult to use, so I've added a feature that allows you to generate a chart for any temperature, not just standard conditions. You can also type in a wind of any direction and speed, and finally you can plot the data as CAFE 400 scores instead of miles-per-gallon.

These charts can be printed on a PostScript printer or can be saved in Adobe Illustrator format for editing and including in page-layout programs.

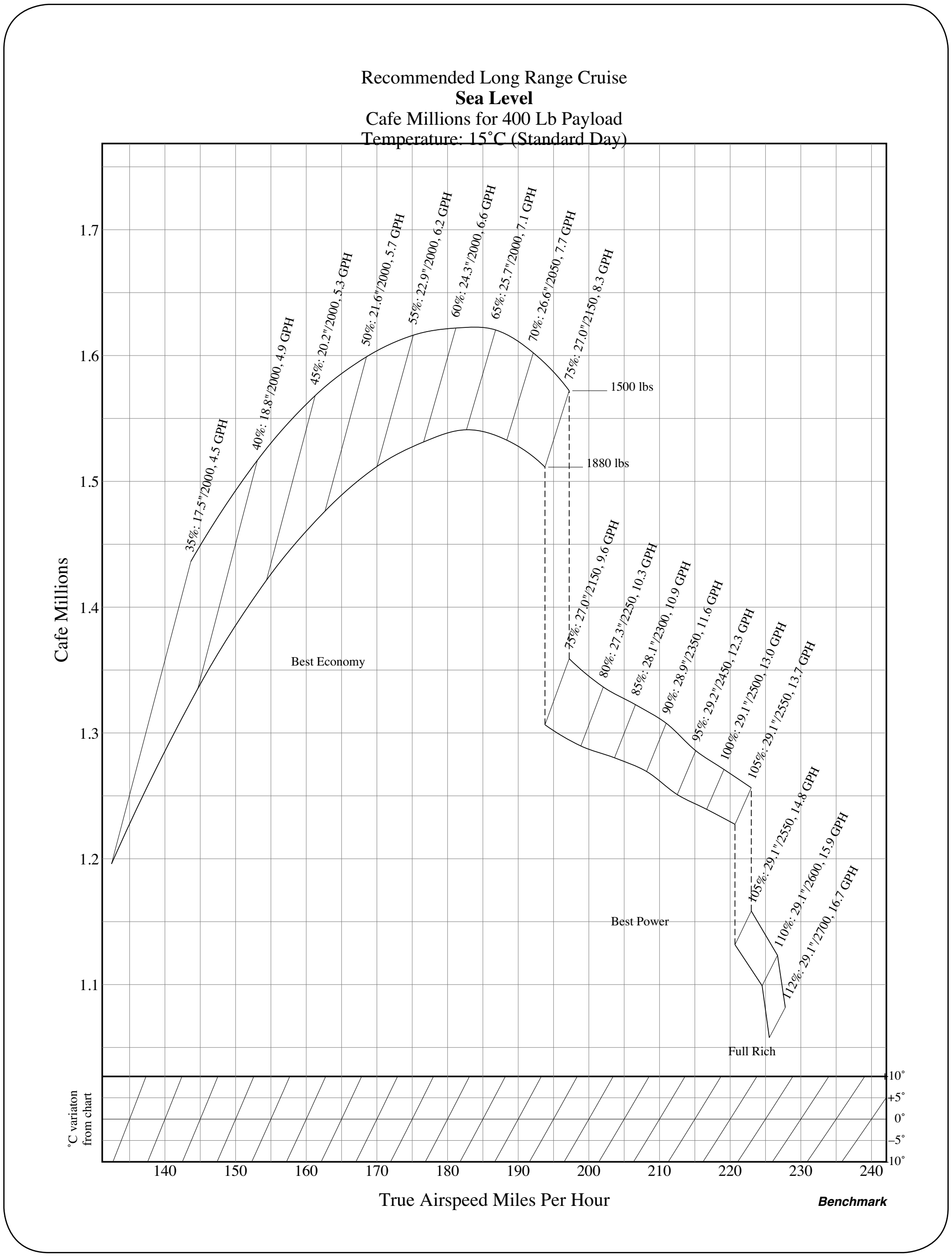
And More

While Benchmark is not intended as a design tool, it can be used in many ways for this purpose. It's quite easy to fudge some phony flight data, then type in your own (optimistic?) Cdo and Oswald E and calculate the performance of the proposed airplane.

You can use Benchmark to try different engines or propellers on your plane. There are separate files for engines and propellers, and you can choose the Install Engine or Install Propeller to do this. It's certainly much easier than trying the real thing! I'm particularly fond of a four-engine Falco with five-bladed propellers.

I've only touched on the basics in this article, indeed the Benchmark manual is 100 pages long and contains an appendix filled with equations and explanations for those who want to follow along on the math. I wrote this program for our Falco builders, each of whom gets a free copy when they fly their plane, but we also sell the program for $250.00. Benchmark runs on the Macintosh series of computers and requires a 1MB Mac Plus or greater and system 6.0 or later.

For those of you with other brands of computers, have mercy on me. Benchmark is the only program of its type in the world, and it has involved an enormous amount of work. It took thousands of hours to write over a five-year period. The program stretches for about 350 pages and at 500K, it's a very large program. If you find this capability interesting, then you should find a friend who has a Mac and use it on their machine—after all, Benchmark is not a program you need to use every day.



Above: Here's what a miles-per-gallon chart looks like for Karl Hansen's Falco with the data plotted for CAFE 400 scores. For essentially all airplanes, the best CAFE scores occur at 65% power, and for Karl's Falco, the most efficient power setting at sea level is 25.7 inches Hg and 2000 rpm.

Goings On at Sequoia Aircraft

Please forgive me for the brevity of this section of the newsletter, but with the extraordinary delays that caused our last builder letter to go out late—who else has published a March publication in May?—I'm a bit burned out on newsletters at the moment and am a bit short of material.

The fuselage frames are continuing apace. We've now got a supply of frame 5 all done, and station 6 should be going together shortly. At this point the jig is all done and all of the parts are cut out. Like frame 5, we will be assembling this the same way we do the wing ribs, with the glue-and-staple technique.

We're also running a batch of tail group ribs shortly, and these will be assembled the same way. However, the principal difficulty is in locating the staples for the rib capstrips and braces. You have the same problem when assembling frame 6. To cure this problem, we're having some staple guides made up in mild steel. The slots are laid out on our CAD system, sent to a local fabrication shop where they are cut out with a laser cutter. Effectively, it's a case of 'printing' on metal, except that the lines are actually burned all the way through the metal.

We have a couple of Falcos out of action right now. Steve Wilkinson tore his engine down, in part to check for damage from the prop strike landing a couple of years ago and in part for an article for *Light Plane Maintenance*. The crankshaft was sent off to Mattituck, and they pronounced it to be junk—lots of hairline cracks over the journals. The really strange thing is that they said the cracks would not have been caused by the prop strike.

And Pawel Kwiecinski suffered the indignity of having his rudder and elevator chopped apart by another airplane's propeller, when the pilot taxied too close to the Falco. A new rudder and elevator are being made now in a repair shop in Minnesota, and it should be a month or so before the work is done.

I suppose this means Pawel won't make Oshkosh as he usually does. However, Cecil Rives, for one, is going to bring his Falco to Oshkosh. He now has the Falco painted, and what an ordeal that turned out to be.

Cecil wanted to use a metallic paint, and he had heard John Devoe rave about Blue River's water-reducible polyurethane paints. Cecil checked around and heard more raves about the paint so he decided to use it. The advantage of this paint is that the metallic variations all use mica, instead of metal flakes, and this insures that it will not interfere with the radio reception.

Top: Joel Shankle's is all red with white stripes.
Above: Cecil Rives's Falco is now painted in metallic silver.

However, after getting some of the paint, Cecil's painter tried it on a few sample boards and could not get it to work at all well. He either got lots of pinholes or a rough 'sandpapery' finish. The painter did a lot of experiments and simply could not get it to work. Finally, the painter called some other painters in the area, and all of them said they could not get the paint to work in the high humidy of Houston.

So Cecil gave up on the Blue River paint and called PPG—who, it turns out, also make a metallic silver paint using mica. The painter used this and got good results, although Cecil is not terribly happy with the finish because there are still a lot of pin holes. That is another story, something about not using a filter, then Cecil bought them a filter but the painter hooked it up backwards, still got pinholes and finally the painter stomped off the jig.

But the good news is that Cecil's Falco is turning out to be a very fast machine. He now has sealed the engine compartment up tightly, closed up the gap behind the spinner and installed full wheel well doors. The other day, Cecil took it up to about 6,000 feet and opened it up. At full power, he was getting 220 mph true airspeed. He's simultaneously amazed and also pondering what else he can do to get even more speed.—*Alfred Scott*

Susan’s Corner

Here I am, fully ensconced in Brenda’s shoes—and they’re not easy shoes to fill I might add. There’s a lot to learn here at Sequoia, but I’m enjoying every minute of it. I must say, this is an interesting and intriguing business. I certainly wish Brenda all the best in her “retirement”.

I’ve talked to several of you on the phone so far, and I must admit you’re certainly a friendly group of guys. Thanks for the warm welcome you’ve all extended to me. It makes me feel just like one of the family.

Working with Alfred is becoming very comfortable and enjoyable. He never seems to get rattled with my “newness” and takes my geography *faux pas* in stride (although some of them have made him chuckle). I think he and I share a lot of the same personality traits, and there are times that we’ll both be so engrossed in and focused on what we’re doing that we won’t speak for hours. That seems to suit us both just fine, so who’s to complain? In all seriousness, I really like it here and the more I learn and become involved, the more I like it. And in my book, you can’t beat that.

Although my knowledge of kitplanes is somewhat limited, I’m not totally new to the world of flying. I’ve flown since I was a little girl (which was about 400 years ago) and my dad was a pilot in WWII and the Korean war. I’ve always wanted to try my hand at flying and sky diving, so who knows, maybe the opportunity will present itself someday.

So far, I’ve bent a lot of fin and stabilizer capstrips, and I’m anxious to see what we’re going to do with them when I’m finished. It all seems like a big jig saw puzzle, and I’m slowly putting the pieces together.

A note about Oshkosh: Alfred will be there but I won’t… this year. I hope next year I’ll have the opportunity to meet a lot of you. You do need to let me know if you want rooms—how many and what dates—so I can firm up the reservations with the Paper Valley Hotel. Please let me know by July 20th what your plans are.

Since this is the first “Susan’s Corner” in the Falco Builders Letter, and considering the fact that I’ve only been on board here for about two months, my first column is fairly brief. Next time, I hope I will have learned a lot more and will be able to write more intelligently about exactly what I’m doing. So until then, Lord willing and if the creek don’t rise, keep those Falco projects going strong, and I’ll help you any way I can from here.—*Susan Rogers*

Calendar of Events

Oshkosh ’94. Falco Builder’s Dinner. 7:00 on Tuesday, August 2 at Martine’s Restaurant at the Midway Motor Lodge in Appleton, Wisconsin. Contact: Susan Rogers at Sequoia Aircraft.

West Coast Falco Fly-In. September 15-18 at Sunriver, Oregon. Contact: Dave McMurray, (707) 443-3088 (days) or 442-4024 (evenings) or at P.O. Box 111, Eureka, CA 95502.

The Great Oyster Fly-In and Gathering of Stelio Frati Airplanes. November 5 at Rosegill Airstrip, Urbanna. Contact: Dr. Ing. Alfredo Scoti at Sequoia Aircraft.

Oshkosh ’95. Plan now to attend the Fortieth Birthday Party for the Falco. All Falco owners are ordered to attend. Expect a massive turnout—Marcello Bellodi is going to bring his Falco from Brazil.

Sawdust

• The perfect life for airheads. Steve Wilkinson was recently in the Bahamas, doing an article for one of the boating magazines on a brand of inflatable rubber boats. Because they were also shooting some photography for some advertisements, there were a couple of models along. One morning, Steve was having breakfast with one of these young lovelies, and in such circumstances he always mentions that he is married. Steve mentioned that Susan is a fanatic about working out. To which the model batted her eyes and said, "Ah, in the perfect life, all I would ever do is work out and groom."

• Someone else's fault. Three years ago, a Christen Eagle crashed into one of the lakes outside Las Vegas. According to the accident reports, it appeared to be a couple of guys flying in hot-and-high air. They were doing aerobatics over the lake and managed to fly it into the lake while coming out of a loop, hitting the water at a 30-degree nose-down angle and killing both men on board. The accident investigation revealed nothing wrong with the plane at the time of the crash. However, the other day one of the relatives filed a suit against Christen Industries (now a shell corporation) and Lycoming blaming the accident on, if you can believe this, "unspecified design defects". Nah, that's not irresponsible litigation.

• The FAA has announced its intention to crack down on the numerous 'co-build' shops that have sprung up recently to assist 'builders' of high-performance aircraft, where in fact the aircraft are simply custom-built for a fee. The first aircraft to be affected will be the BD-10 jet, where the Nevada company Fox 10 has ten BD-10 kits under construction. This is actually nothing new with the FAA; there have always been builders who hire assistants and no one has ever gotten excited about that, but any time you set up a shop that starts to look like an assembly line, the FAA is going to put you out of business. This happened a number of years ago with a shop multi-building Midget Mustangs, and it's going to happen now with shops turning out BD-10, Questairs, and the big-iron Lancairs and Glasairs.

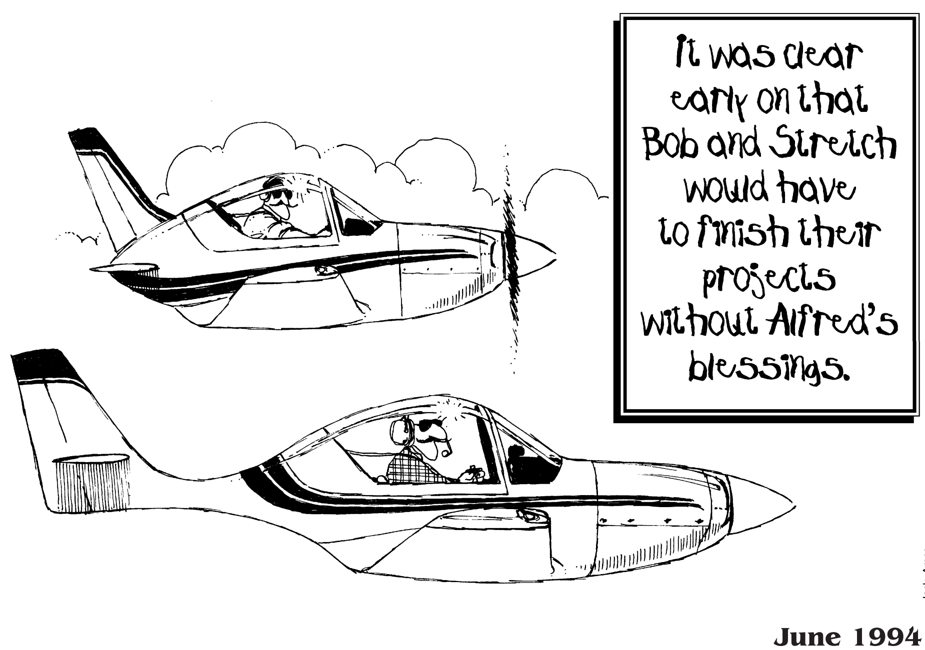
• Plastic bashing from the sea. Looking for another reason to hate plastic? According to an article in the *New York Times*, most of the 14 fiberglass boats in the 32,000-mile Whitbread Round the World race have experienced an "insidious threat—weakened hulls that start flexing like the sides of a child's swimming pool." The race is being called the "delamination derby" because of problems with the hull materials with many of the yachts. Famed yacht designer Olin Stephens says there is always an "ignorance factor. The materials change all the time, and the way they're put together makes a difference." Much of the problems are being caused by cracks in the foam core, and when the problems set in, the crews improvise by tearing apart their bunks, salvaging bed pipe frames to brace the interior walls of the boat. We're talking about million-dollar boats here, being sailed with pipes and frying pans bracing the hulls.

• One year ago Dr. Ing. Alfredo Scoti caught holy hell from the Glasair folks for his article, "Lite Engineering and the Myth of Simplified Certification", in which he questioned the amount of engineering that goes into a typical kitplane. Scoti recommends reading "Flight Instructor's Nightmare" in the June 1 issue of *The Aviation Consumer*, dealing with the failure of the AN-4 (1/4") axle retention bolts on the Glasair III, about how qualified engineers agree that the bolts *will fail* at a landing impact of approximately 3 Gs—a typical dining-room chair is stronger than that—and that Stoddard-Hamilton has a "new structural analysis" which indicates a redesign. Good grief. The tension loads on the axle retention bolts is the simplest sort of calculation that any freshman engineering student can do in a few minutes. When Dave Thurston designed the Sequoia 300 landing gear, he used two AN-6 (3/8") and two AN-5 (5/16") bolts for a two-seat airplane of equal engine power. This bolt selection, he says, "will take anything that the axle or wheel will take", and it is considered a standard installation for aircraft of this class—indeed, the brakes come from Cleveland have bolt holes for these size bolts. All this suggests that the engineering was not simply performed inaccurately, but that it was never performed at all. In a news conference, the emotional Scoti rapped on his chest with a clenched right fist and said "It make-a me very angry to hear about-a this. I don't-a get it. Tell-a me again why I'm a horrible person for suggesting that there is lite engineering in the kitplane field."

• Back to the future. During 1946-49, the Czech company Aero license-built the famous Bücker Jungmann biplane. They're at it again, producing brand-new Jungmanns (which they call C-104's) complete with locally-built inline-four Walter Minor engines. There's also an option for 'firewall aft' airframes for owners who wish to do their own engine installations.

• Getting close to flying. Alan Hall's Falco has been essentially ready to fly since early this year and awaits his nephew test pilot. Dave McMurray's Falco will be moved to the airport by the time you get this and will be flying in the next week or so. Dwight Lapeare has a Mazda-rotary-powered, built-from-Falco-plans airplane hopping down the runway in Ontario. George Barrett is putting the final touches on his Falco and plans to fly in September. In Italy, Giovanni Fulcheri's Falco is essentially finished and needs only an engine. In Australia, Stephen Friend's Falco is perilously close to flying.

• See ya there. During the Oshkosh airshow, the Falco Builders Dinner will be held at 7:00 on Tuesday, August 2 at Martine's Restaurant at the Midway Motor Lodge in Appleton, Wisconsin. Please let Susan Rogers know if you can make it.



Mailbox

Dear Don 'Fredo:

It is hard to believe I have lived almost four and a half decades and missed out on all the fun of aerobatics until now. Thanks so much for your hospitality this weekend, and for introducing me to your friend, Joel.

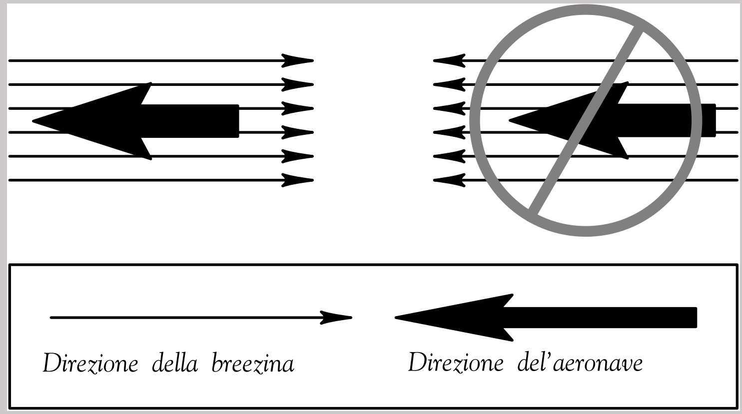
The enclosed plaque was forwarded to me by the second assistant undersecretary of the Italian Air Ministry. He has apparently been trying desperately to locate you ever since you acquired your Falco. I only took two semesters of Italian in college, but if I understand his letter correctly this plaque is to be mounted prominently on the instrument panel of your aircraft. I told him I was glad to help. I also told him his timing was miserable.

Mark James
Richmond
Virginia

PS. I was able to rinse out my undershorts before any stains set permanently.

The most embarrassing non-fatal takeoff in a Falco took place on May 14, when I took Mark James for a ride in the Corporate Disgrace. The tower at the Richmond airport directed us to runway 2, and on takeoff I noticed that the plane took a long time to get off the runway—maybe because we're two heavy men and had full fuel. At Joel Shankle's, I landed in the same direction, and noted that we were really moving and that it required more braking than normal. After washing the plane behind Joel's hangar, we taxied out for takeoff. The acceleration was terrible, and as we started to skip along the ground I realized that this takeoff was not going well at all. I chopped the power, stood on the brakes, and we went screeching and skidding off the end of the runway, sliding sideways on the gear down the hill at the end and just barely cornered back up the hill. If I had waited another quarter-second before aborting, we would have hit the trees down by the creek. As we bombed back up behind the hangar, Joel was grinning from ear to ear. "Why don't you take off into the wind?" he said. "There's a fifteen knot wind coming down the runway." Lordy, did I feel stupid, but I didn't believe the fifteen knot figure until we broke ground easily half-way down the runway.—Scoti

Attenzione!



In avvanza di tutti acenzioni, il illustro piloto betta checka da breezina con molto precisione! Questo aeronave she no lika da breezina poo-poo. She solo lika da breezina snoota. Acenzione con la breezina poo-poo e molto embarazzando al piloto, e forse causa movimenti degli intestini massivi e involuntarie agli passagieri.

Instrument panel warning plaque from Mark James. See letter at left.

Dear Jonas,
I read your report on the swing-wing Falco modification. Interesting idea. I am strongly considering building the airplane from plans (cheaper) as I have access to a fairly well-equiped wood shop (Dad's). I can see how the new Vne and performance specs would be drastically altered.

I am most interested in the idea and installing the mechanism in the initial construction. I would use cold hard cash. Of course, if goods-barter would be better for your friend, this could be arranged. I currently have a nephew living in Slovakia, and he claims to be so close it doesn't matter.

I would be most interested in more details on your project, and how to contact your source. The potential is mind-boggling.

John Elliott
Farmington, Missouri

After reading the Falco Builders Letter, March issue, I feel I have to express some of my experience with Jean Peter's epoxy system. The comments by George Richards and Alfred Scott leaves a big grin on my face because of someone not really doing any hands-on research and becoming an armchair critic.

Over the last 10-12 years, I have had considerable experience in polyester, vinyl ester, Safe-T-Poxy and the West System. All are good systems under controlled conditions and personal protection as to odor and toxicity. Some of these systems are very allergenic. I have used the Peters system for eight years. During this time, it has been used to build a KR2. Many, many test pieces have been fabricated for my own testing and for our Dept. of Transport. My propellers have all been glued with this system. The prop that is presently on the KR2 has over 100 hours on it without any sign of failure or delamination.

With cowlings made with this resin, I had to prove that it would not sustain a flame. Our tests for the DOT were run with an acetylene torch; it burned the resin but would not sustain a flame. The cowlings after a few flights reached a full cure because of the engine heat, and became firm as a cowling should.

With the use of an autoclave, two booms have been constructed for an Aero Magnetometer company. One five feet long and the other 14 feet long, using the Peters system. The five-footer is mounted on the fin of a Cessna 172XP and has been in use

Top: Joel Shankle and Mark James pull the Corporate Disgrace out for the near-disastrous takeoff. Above: Cecil Rives now has his Falco painted in metallic gray.

for 3-1/2 years; the 14-footer had to be shortened to 12 feet to get it in the proper position on the resonance curve and has been in service for two years mounted on the fin of a Cessna 310. On the last inspection, no fatigue or delamination was found on either boom.

This system mixed with microballoons has been used as a light automotive body filler with excellent results. Another good test was made when a friend, with a leaky exhaust muffler on his motorcycle, wrapped the muffler with fiberglass and the Peters system. After three years, when the bike was sold, there was no evidence of any failure of the muffler.

I would challenge the both of you and the manager of Ciba Geigy (who probably does not have any hands-on experience with Araldite 509) to try any of my test pieces and propellers I have constructed for failure of a glue joint. Try it—boil some test pieces in water for 4-5 hours and see if a glue joint fails.

In my opinion, there are two types of people in this world—one who educates himself and experiments, and the armchair types who have not experimented and are an authority with unfounded opinions. This is an unsolicited letter, but I am highly biased to this proven system with justification.

Adrian H. Carter
Calgary, Alberta
Canada

We're delighted to publish this glowing report, however you're offering anecdotal evidence. I'm still interested in seeing independent test data. I'm sorry, but I'm too busy to entertain the idea of testing adhesives when I can purchase other adhesives for which ample test data is available.—Alfred Scott

Enclosed are the oleo piston, Schrader valve and valve seat polishing tool. Your usual fast response is greatly appreciated. The new piston has been holding pressure for over 10 days now which is a new record for this strut. The Falco now has over 64 hours tach time and flies very well. I'm working on the interior trim and hope to have a stripe on the fuselage soon, but after the long winter downtime, I just don't like to tie it up very long.

Dick Reichenbach
Bay City, Michigan

Being a professional metallurgical engineer, the more I read and hear about other aircraft, the more I appreciate the Falco. Locally, we had a single-engine Piper get caught in some nasty weather. The pilot, his wife and 4-year-old son were lost because the aircraft broke apart in the air. This underscores to me the aging metal aircraft still in service. I want nothing to do with this. I'll stick with some of the modern, hi-tech structural materials with tremendous fiber strength. These are less susceptible to fatigue than aluminum is. These materials, as you know, are wood, a renewable resource. Your support and newsletters are sincerely welcomed.

Robert S. Stosky
Masury, Ohio

Yesterday in the same mail I received my copy of *Sport Aviation* and a copy of the *Aviation Bulletin*, a publication of our Civil Aviation Authority. Bob Hoover's license problems are featured in both. Hoover had been invited to officiate at the first-ever pylon races to be held in Australia and to put on his display. In the absence of a U.S. license, he had to obtain an Australian one. I wonder if he will be able to obtain reciprocal recognition of his Australian license!

Incidently, Guido Zuccoli was at the races with his Sea Fury and the Falco. There was a race that featured among other aircraft (some plastic), my old SF.260 and the Falco. The latter beat the SF.260 by a small margin.

Ian Ferguson
Dookie, Australia

It never hurts our feelings to hear of 180 hp Falcos beating 260 hp SF.260s. Luciano Nustrini used to regularly beat SF.260s in the races in Italy, and he loved every minute of it.—Alfred Scott